Electronic Supplementary Information (ESI)

Label-free multidimensional bacterial characterization with ultrawide detectable concentration by microfluidic impedance cytometry

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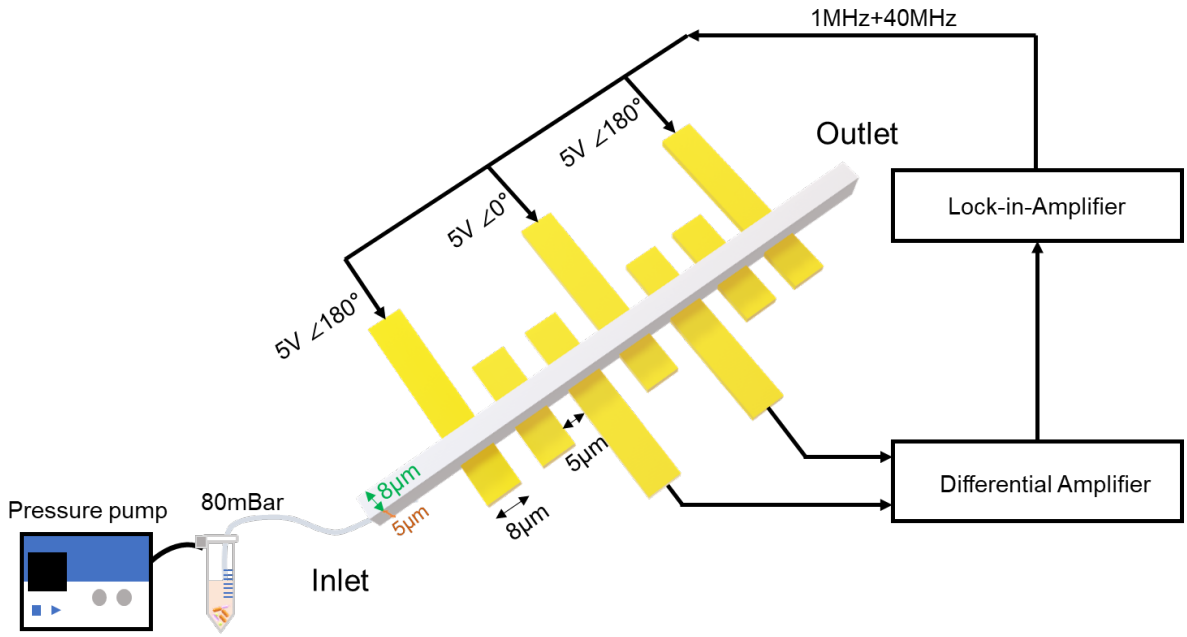

Figure S1 Overview of electrical impedance-based microfluidic cytometry for bacterial detection with some key physical dimensions and operational parameters.

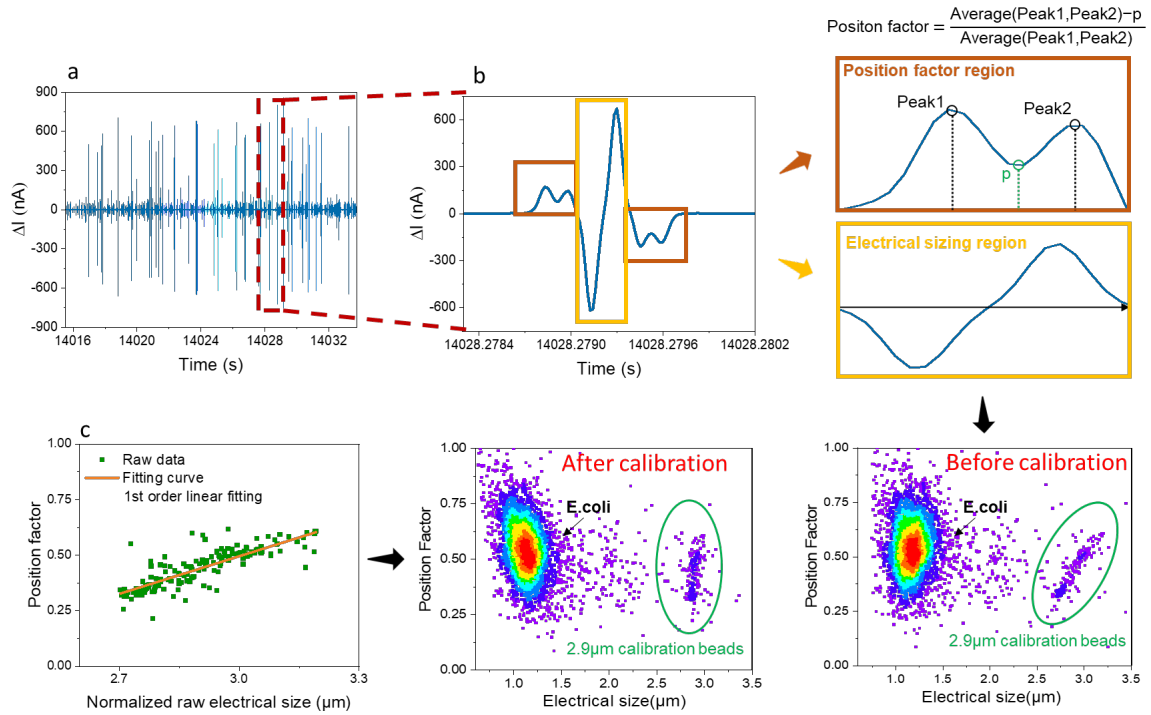

Figure S2 Measured impedance signal of bacterial detection and data calibration. (a) Raw impedance signals with an indication at the single-bacterium event level. (b-c) Calibration process by the position factor. *E. coli* is used as the model bacteria.

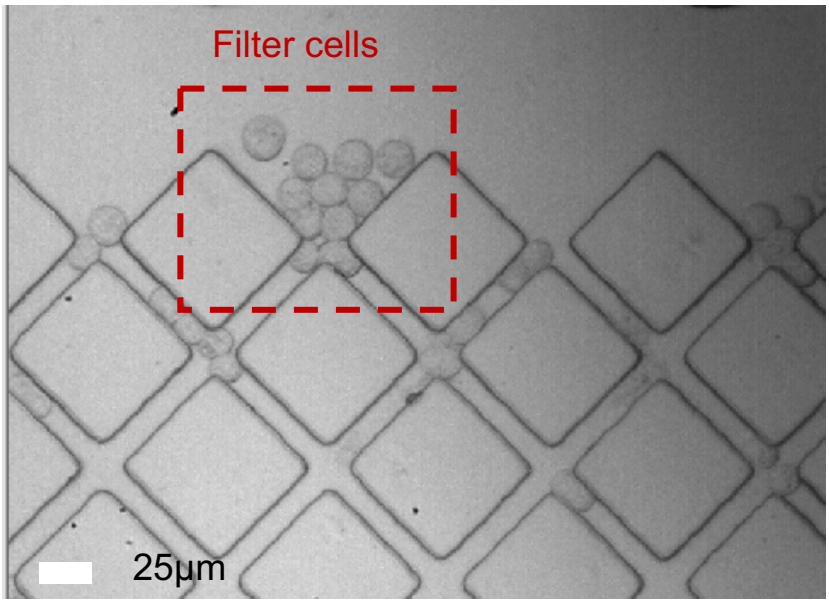

Figure S3 A microscopic image of the filtration structure prior to the impedance detection channel. 3T3 cells are here used to demonstrate the filtration effect.

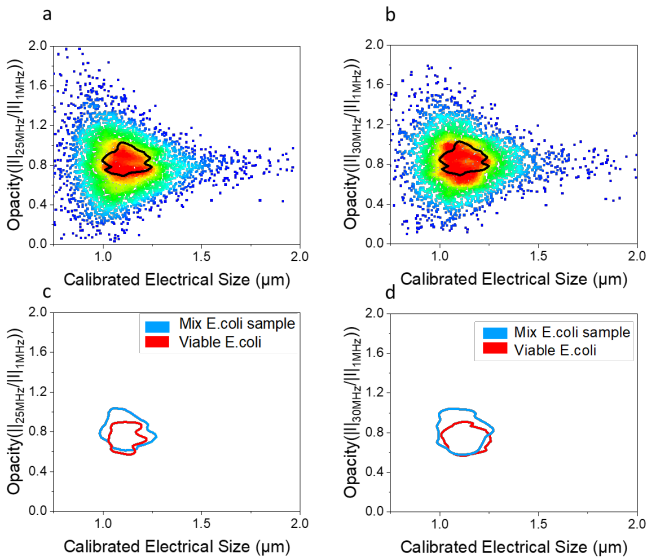

Figure S4 Electrical impedance-based live and dead *E. coli* classification. Impedance scatter plot of bacteria (mixed live and dead *E. coli* sample, 5000 events) measured at 25 and 30 MHz. Sample measured at opacity (|Z|@20MHz / |Z|@1MHz) is used to define the reference contour shown in black. (e-h) Overlaid contour curves from mixed *E. coli* sample (blue) and live *E. coli* (red) at 25 and 30 MHz frequencies for classification of live and dead *E. coli*.

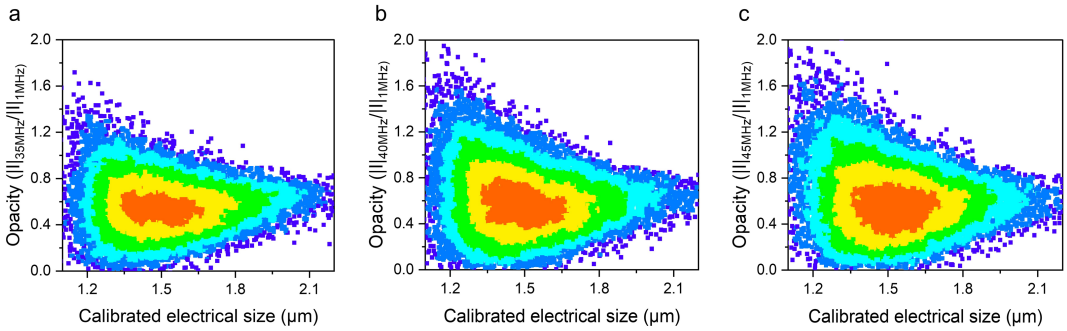

Figure S5 Impedance scatter plot of *Klebsiella pneumoniae* measured at 35, 40 and 45 MHz frequencies.

Table S1. Parameters in simulation

Parameter	Value (Gram Positive)	Value (Gram Negative)
$h_{Channel}$	10 μm	
$w_{Channel}$	10 μm	
$w_{electrode}$	10 μm	
$l_{bacteria}$	1 μm	
$l_{bacteria}$	0.5 μm	
ε_{medium}	80	
σ_{medium}	1.6 S/m	
$d_{outer\ membrane(gram\ positive)}$	80 nm	7 nm
$\varepsilon_{outer\ membrane(gram\ positive)}$	60	34
$\sigma_{outer\ membrane(gram\ positive)}$	3.3 S/m	1e^{-4} S/m
$d_{mid\ membrane(gram\ positive)}$	N.A.	10 nm
$\varepsilon_{mid\ membrane(gram\ positive)}$	N.A.	60
$\sigma_{mid\ membrane(gram\ positive)}$	N.A.	3.3 S/m
$d_{inner\ membrane(gram\ positive)}$	7 nm	7 nm
$\varepsilon_{inner\ membrane(gram\ positive)}$	4.9	4.9
$\sigma_{inner\ membrane(gram\ positive)}$	1e^{-7} S/m	1e^{-7} S/m
$\sigma_{cytoplasm}$	0.22 S/m	
$\varepsilon_{cytoplasm}$	100	